Environmental Effects on Variable Practice of Example Formats

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Abstract

There is a lack of women in mathematics-related fields. This might be due to *stereotype threat*, when a person performs worse than usual when presented with a negative stereotype because they are worried they will prove the stereotype to be correct (Steele, 1997). As practice schedules can affect performance (Carlson & Yaure, 1990), this experiment measured math performance after implementing blocked or random practice schedules and an activated or inactivated negative stereotype. Forty-eight college students learned probability from worked examples and practice problems and were tested on overall math performance and other aspects of learning. Results suggest that, in general, a blocked order tends to yield greater math performance, especially under the effects of a negative stereotype. Future research should examine retention, in addition to acquisition, of the learning materials.

Environmental Effects on Variable Practice of Example Formats

As one might notice while taking mathematics and math-related science courses in college, males more often than not outnumber females. This means that fewer women will pursue mathematics and math-related science professions upon graduating. The small number of females in mathematics classes, and thus pursuing mathematics degrees, can have a detrimental effect on females' performance and impact in the field (Inzlicht & Ben-Zeev, 2000, 2003; Sekaquapetwa & Thompson, 2003). This impedance in performance then in turn discourages females from pursuing mathematics and related fields. It is important to investigate why females do not perform as well as males, as it discourages them from pursuing these fields. This results in less qualified individuals in these fields. Finding a way to better women's performance in these fields might help encourage them to pursue math-related professions. This boost in qualified individuals joining math-related fields would undoubtedly help increase achievement within the fields.

Understanding why women tend to not perform as well as men in math-related fields is an important step in being able to find how to best improve their performance. It is not simply the fact that females are not as capable as men in becoming fine mathematicians. Why then, one might ask, do women not always perform up to their caliber? One answer seen in the literature to this question of why women's performance in mathematics might falter is the theory of *stereotype threat* as presented by Claude M. Steele (1997). Research has found that when certain environmental factors such as stereotype threat are suppressed, women not only perform as well as men on mathematical assessments, but they also have the ability to surpass them (Good, Aronson, & Harder, 2008)!

Stereotype threat refers to when a person is "at risk of confirming, as self-characteristic, a negative stereotype about one's group" (Steele & Aronson, 1995, p.797). This means that as a member of a minority group who is labeled with a negative stereotype (e.g., African-Americans are not as good as Caucasians in completing verbal tasks), they might not perform as well as they normally would when threatened. This is because they might be worried that they might prove the negative stereotype to be "correct" (Steele & Aronson, 1995). This effect can be seen in the performance of a vast number of minorities in a variety of tasks, including women and mathematics. "When women perform math, unlike men, they risk being judged by the negative stereotype that women have weaker math ability" (Spencer, Steele, & Quinn, 1999, p.4).

Stereotype threat affects those who associate to a high degree with a domain (i.e., women who feel that they are good at math and believe it is important to them to do well in math) more so than those who do not (Davies, Spencer, Quinn, & Gerhardstein, 2002). These individuals tend to experience arousal and mental load when compared to those who do not associate themselves with math. As a result, when under the effects of stereotype threat, those who associate to a high degree with the mathematics domain tend to perform worse on difficult math problems when compared to their performance when not under the effects of stereotype threat; they also perform worse on difficult math problems than those who do not associate highly with the math domain (Keller, 2007). Thus, this might be true for math problem types that high math domain identifiers are just learning and with which they are not yet very familiar. This can be seen when women who are in upper-level math classes still suffer from stereotype threat though they are indeed very good at math due to their extensive math background (Good et al., 2008).

How then can we suppress stereotype threat in classrooms in order to help women perform at their full capability? Past research has suggested a variety of methods including: explicitly stating that gender differences do not occur on an assessment (Spencer et al., 1999), having women not be outnumbered by men in a group when doing math (Inzlicht & Ben-Zeev, 2000, 2003; Sekaquaptewa & Thompson, 2003), explaining the concept of stereotype threat to females and how it effects their performance in hopes of them not letting it effect them (Johns, Schmader, & Martens, 2005), amongst others. The problem with these methods is that they use a responsive approach rather than a preventative one. The current methods can be successful only if an instructor chooses to implement the method in addition to their role as teacher. The methods require the instructor to teach the material, yet also try to negate the effects of stereotype threat afterwards by reading a statement before an assessment and/or by balancing male to female ratios during tests, amongst other things. If an instructor is not willing to move beyond their role of teacher, the effects of stereotype threat will continue to be present.

A method not seen in the literature as a way to lessen the effects of stereotype threat is by altering the original teaching materials. This type of method would not demand anything of the instructor aside from teaching, thus having an increased chance of being implemented in classrooms. This study looked at how the effects of stereotype threat could be negated through redesigning instructions during learning, as it had not been investigated in the past as a means to reduce the effects of stereotype threat. By doing this females could overcome the effects of stereotype threat even if factors that would usually have affected stereotype threat were present. If females could learn from learning materials with enough confidence, they would able to perform well on assessments. This is because they would not be preoccupied with the thought that they might solve the problems incorrectly and prove the negative stereotypes associated with women and math to be correct.

High math-identifiers refer to those who identify themselves with being good at math and feel it is important for them to succeed in math. When women who are high math-identifiers are faced with a situation in which stereotype threat has been suppressed, they succeed in solving difficult math problems and perform extremely well in solving ones that are not as difficult (Keller, 2007). *Difficult* problems refer to those that had been most often missed by people when solved during previous testing, while *easy* problems are those most often solved correctly (similar to classifications used in standardized testing). When faced with a situation in which they are experiencing stereotype threat (i.e., if they were told that males tend to outperform females on that specific assessment), high math domain identifiers tended to solve less difficult math problems correctly, and they solved the same amount correct of the easier problems as they did when not experiencing stereotype threat (Keller, 2007). This suggests that if *difficult* math problems were perceived as *easy*, then they might be unaffected by stereotype threat.

This study attempted to create a way for difficult math problems (i.e., probability problems that participants have not learned about previously) to become easier for the participant, and thus solvable even under stereotype threat. Acquisition of the new material was facilitated through manipulation of the practice schedule (the manipulation of the ordering of worked examples during learning). Previous research had looked at the effects of blocked and random practice schedules on acquisition and retention, and had found that "random practice schedules produce poorer acquisition performance but superior retention relative to blocked practice" (Carlson & Yaure, 1990). Shea and Morgan (1979) additionally found that a random order aids in the transfer of learning, especially for "task[s] of greatest complexity." "Transfer of learning and knowledge" is important as it ensures that a person is able to apply what they have learned in theory to actual problems that might arise (Barnett & Ceci, 2002). To explain it simply, it would not be beneficial to the student if he or she only learned how to solve *1+1=2*, but rather that they be able to apply the concept of addition to different looking problems later on.

The effects of these practice schedules on the learning of probability concepts in females and the effects of negative stereotype activation or suppression as a result of stereotype threat (or lack thereof) on mathematical performance were investigated. If a certain instruction-type helped females learn new math concepts and helped them perform better on math assessments regardless of whether they were experiencing an activated negative stereotype or not, instructors could implement it as a teaching style in order to help the performance of those effected by stereotype threat.

Method

Participants

Forty-eight female students from the Georgia Institute of Technology, who had not previously taken a college probability class, were enrolled in the study. Participants were offered extra credit towards their psychology classes at the institute as reimbursement for their time.

Materials and Procedure

A number of learning and testing materials were used as a part of the study. After signing the informed consent form, a domain identification questionnaire was administered in order to survey participants' math domain identification, based on the questionnaire used in Keller's (2007) study. The median score on the questionnaire was used as the division between high and low math identifiers. These data were later used to explore the effects of the negative stereotype on the math performance of those with high math domain identification as they are most affected by stereotype threat (Davies et al., 2002). A demographic questionnaire for data collection about mathematical background was administered at the end of the experiment.

After the math domain identification questionnaire, the learning portion began. The participant was first given an introduction to probability, which introduced general probability concepts (i.e., the concept of a random experiment, the probability of an individual event and of a complex event, and how to combine probabilities). Each participant was given worked examples covering the four different types of probability problems: permutation with replacement, permutation without replacement, combination with replacement, and combination without replacement. Each worked example taught the participant how to select the correct formula, how to select the correct variables (n and k), and how to solve for the final answer. These methods were similar to what was done in past studies of probability instruction with order manipulation (Gane & Catrambone, 2007, 2009).

The examples were presented in a molar format instead of a modular one, even though studies have shown modular examples to be beneficial when learning probability (Gerjets, Scheiter, & Catrambone, 2004). A *modular* format refers to a format "where complex solutions are broken down into smaller meaningful solution elements that can be conveyed separately," while a *molar* format is one that "focuses on problem categories and their associated overall solution procedures" (Gerjets et al., 2004). A molar format had been chosen in order to be able to manipulate the ordering of the worked examples. This could not have been done with a modular format because to break down complex probability into smaller meaningful components is to teach it as the *individual-event approach*; as a result, it could not have been presented in multiple orders. A molar format, however, presents problem categories; in the case of probability these categories are the various probability formulas. Since there are four different probability formulas, the order that they can be presented to the learner could be manipulated. This way, if an ordering was observed as more beneficial to learners, it could be applied to fields in which a modular format might not be an option.

Participants were presented 16 worked examples in either a blocked or random order, depending on to which condition the participant had been assigned. A *blocked order* meant that participants received all of the same type of probability problem types in each packet. A *random order* meant that participants received four different probability problem types in each packet in various orders. Past studies had suggested that a blocked ordering of examples might be more beneficial as they might help learners distinguish *structural features* of the problems (i.e., the "underlying solution method") (Quilici & Mayer, 2002). Other studies, however, had suggested that a random ordering of examples might be more helpful as it provides a distribution of practice (Jacoby, 1978) and might help the learner by allowing him or her to compare and contrast the different structural features of each problem (Shea & Morgan, 1979).

Each learning packet was followed by a practice problem similar to the worked examples presented, which participants could solve on their own in order to gain a better understanding of the material. All participants, regardless of condition, received the same practice problem. The practice problem was the same type of probability problem that members of the blocked condition had seen in each packet (see Table 1 for orderings and Table 2 for probability formulas).

Table 1.

Blocked and Random Worked Example Orderings and Practice Problems

Packet	Blocked	Random	Practice Problem
1	Permutation without Replacement Permutation without Replacement Permutation without Replacement Permutation without Replacement	Permutation without Replacement Permutation with Replacement Combination without Replacement Combination with Replacement	Permutation without Replacement
2	Permutation with Replacement Permutation with Replacement Permutation with Replacement Permutation with Replacement	Combination with Replacement Combination without Replacement Permutation with Replacement Permutation without Replacement	Permutation with Replacement
3	Combination without Replacement Combination without Replacement Combination without Replacement Combination without Replacement	Combination without Replacement Permutation without Replacement Combination with Replacement Permutation with Replacement	Combination without Replacement
4	Combination with Replacement Combination with Replacement Combination with Replacement Combination with Replacement	Permutation with Replacement Combination with Replacement Permutation without Replacement Combination without Replacement	Combination with Replacement

Table 2.

Probability Formulas

Formula Names	Probability Formulas
Permutation without Replacement	$\frac{n!}{(n-k)!}$
Permutation with Replacement	n^k
Combination without Replacement	$\frac{n!}{(n-k)!k!}$
Combination with Replacement	$\frac{(n+k-1)!}{(n-1)!k!}$

Following the learning portion, a single test was administered to all participants. In addition to three isomorphic problems on the test (problems that could be solved the exact same way as the worked examples and the practice problems), transfer problems were also included. It is important to include transfer problems in addition to those that replicate the learning materials in order to ensure *learning* and not simply memorization (Schmidt & Bjork, 1992). Transfer problems required applying two formulas instead of one (as learned in the worked examples) and then combining the probabilities by multiplying (as taught in the probability introduction). Three near transfer problems (requiring the application of the same probability formula twice) and three far transfer problems (requiring the application of two different probability formulas) were included, leading to a total of nine problems on the test: three isomorphic problems and 6 transfer problems.

The assessment was prefaced by the following statement written on the front of the test, adapted from Spencer et al.'s 1999 study, which is the wording used most often in the relevant literature:

> As you may know there has been some controversy about whether there are gender differences in math ability. Previous research has sometimes shown gender differences (where males outperform females) and sometimes shown no gender differences. Yet little of this research has been carried out with women and men who are very good at math. You were selected (as a Georgia Tech student) for this experiment because of your strong background in mathematics. This particular test that you are about to take has been shown *(OR has been shown not)* to produce gender differences.

The statement was also read aloud by the experimenter in order to ensure awareness of the stereotype threat manipulation (Kiefer & Sekaquaptewa, 2007). The test was administered in order to examine participants' overall understanding of the material by having participants solve probability problems completely on their own from start to finish. A formula sheet was given to the participant during this test. Following the experiment, participants were fully debriefed on all aspects of the experiment, and had all of their questions answered.

Design

This study used a 2x2 between-subjects design in order to investigate the relationship between instruction format and stereotype activation on math performance. Only those who had never had a college-level probability course were included in the study (as the learning material taught probability concepts) in order to ensure all participants shared the same background on the learning material (Davies et al., 2002). Participants were run one at a time in order to ensure that a group's gender composition did not affect their performance (Good et al., 2008; Huguet & Régner, 2007; Inzlicht & Ben-Zeev, 2000, 2003) by a single experimenter, as the gender of the experimenter had not been found to affect participants' performance in past research (Johns et al., 2005).

Participants were assigned to one of two conditions (activated negative stereotype or inactivated negative stereotype) and were given one of two types of instructions from which to learn probability concepts (blocked or random order).

Results and Discussion

Analyses were conducted using data from the 48 participants. However, data from participants scoring less than 75% correct on the practice problems were not included. It was assumed that any errors on the assessment portion of the experiment by these participants would be attributed to a lack of understanding of the material, and not due to negative stereotype activation or inactivation. Their data was left out of analyses as to not skew the results because their low performance on practice problems during the learning portion suggested that they never truly understood the material. Over all, data from 22 participants in the random order condition and 20 participants in the blocked order condition were used. Of these participants, 23 were in the inactivated negative stereotype condition and 19 were in the activated negative stereotype condition. Problems that were solved differently (not using the taught formulas) were not included in the analysis in order to eliminate errors not caused by incorrect categorization of problems and variable selection.

Additionally, though the administered test included 9 problems, only scores from 8 of those problems were used in the following analyses. This was done because one of the isomorphic problems was altered after data collection had begun. Thus, to ensure equality amongst all participants' data, only the 8 unchanged problems were examined.

The Effects of Stereotype Threat and Variable Practice Schedules on Math Performance

Participants' overall math performance was assessed using both Overall Performance Index-1 (OPI-1) and Overall Performance Index-2 (OPI-2). These indices were computed by assigning a different percentage weighting to each aspect of problem solving – (1) categorizing it correctly as an isomorphic problem or a transfer problem, (2) categorizing it as the correct probability problem type (permutation without replacement, permutation with replacement, combination without replacement, combination with replacement), (3) identifying and selecting the correct variables (n and k), and (4) solving for the correct final answer.

Under OPI-1, categorizing it correctly as isomorphic or transfer (by applying either one or two formulas during solving) was weighted as 15% of the final answer. Choosing the correct probability problem type was weighted as 35% of the final answer, identifying and selecting the correct variables (n and k) was weighted as 35% of the final answer, and solving for the correct final answer was weighted as 15% of the final answer. As the participants' performance regarding categorization of the probability problem type and their identification and selection of variables (n and k) was of greatest interest, those two aspects of problem solving were weighted more heavily than the other aspects. Another index that was used to calculate participants' overall math performance was OPI-2. This index was computed by weighing all four aspects of problem solving equally (25% each).

Overall math performance as a function of OPI-1 and OPI-2. A two-way between-groups analysis of variance was conducted to investigate the impact of variable practice schedules and negative stereotype activation on math performance, as measured by the two indices. Subjects were divided into two groups based on their randomly assigned practice schedule condition (PS) (Blocked Order [BLOCKED] or Random Order [RANDOM]) and also based on their randomly assigned negative stereotype activation condition (NSA) (Activated Negative Stereotype [ACTIVE] or Inactivated Negative Stereotype [INACTIVE]).

Though the main effects and the interaction effect between the two variables did not reach statistical significance, for OPI-1: PS: $F(1, 38) = 0.36$, $p = 0.55$; NSA: $F(1,38) = 0.01$, $p = 0.92$; PS x NSA: $F(1, 38) = 0.50$, $p = 0.49$, for OPI-2: all Fs <1, interesting trends were noted (see Table 3). For participants in the INACTIVE condition, those who studied RANDOM examples performed approximately equally to those who studied BLOCKED examples. However, for participants in the ACTIVE condition, those who studied BLOCKED examples performed better than those studying RANDOM examples. Those in the RANDOM condition performed similarly as those in previous literature, where the activated negative stereotype led to a decrease in the math performance of females (Steele & Aronson, 1995). The opposite was true for those in the BLOCKED condition, however, as their math performance got better with the introduction of an activated negative stereotype.

Correct categorization of isomorphic and transfer problems. A two-way between-groups ANOVA was also conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize each test question as isomorphic or transfer (by applying either one or two formulas during solving).

Though the main effects and the interaction effect between the two variables did not reach statistical significance (all *F*s < 1), interesting trends were noted (see Table 3). Again, for participants in the INACTIVE condition, those who studied RANDOM examples performed approximately equally to those who studied BLOCKED examples. However, for participants in the ACTIVE condition, those studying BLOCKED examples performed much better than those studying RANDOM examples. These results are similar to those seen in overall math performance as a function of OPI-1 and OPI-2.

Previous studies in the literature had not investigated the exact effects of stereotype threat on specific aspects of problem solving (i.e., categorization of isomorphic and transfer problem types). As a result, significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected. It was believed, however, that performance would be similar to overall math performance where an activated negative stereotype would lead to a decrease in performance (Steele & Aronson, 1995). In that sense, those in the RANDOM condition performed similarly as those in previous literature in that the activated negative stereotype caused the math performance of women to decrease. In this case, it was their performance on correctly categorizing problems as isomorphic or transfer problems that decreased. The opposite was true for those in the BLOCKED condition, however, as their performance increased with the introduction of an activated negative stereotype.

Correct categorization of probability problem types. Similar to previous analyses, a two-way between-groups analysis of variance was carried out to explore the impact of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize each test question as the appropriate probability problem type.

Though the main effects and the interaction effect between the two variables did not reach statistical significance (all *F*s < 1), some interesting trends were seen again (see Table 3). For those in the INACTIVE condition, those who studied RANDOM examples performed a bit better than those who studied BLOCKED examples; this was seen even more so for those in the ACTIVE condition.

The exact effects of stereotype threat on specific aspects of problem solving, such as categorization of probability problem types, had not been investigated in previous studies, so significant differences in performance under an activated and inactivated stereotype were neither expected nor unexpected. It was believed that performance would be similar to overall math performance where an activated negative stereotype would lead to a decline in performance (Steele & Aronson, 1995). In that sense, those in the RANDOM condition performed similarly as those in previous literature, where the activated negative stereotype led to a decrease in correct categorization of probability problems types for women. The opposite was true for those in the BLOCKED condition, however, as their performance increased with the introduction of an activated negative stereotype.

Correct identification and selection of variables n and k. A two-way between-groups ANOVA was again conducted to explore the effects of variable practice schedules and negative stereotype activation on participants' ability to correctly identify and select the variables needed in probability formulas (n and k).

Though the main effects and the interaction effect between the two variables were not statistically significant (all *F*s < 1), some noteworthy trends were seen (see Table 3). For those in the INACTIVE condition, those who studied RANDOM examples performed a bit better than those who studied BLOCKED examples. However, for those in the ACTIVE condition, those studying BLOCKED examples performed much better than those studying RANDOM examples. These results are similar to those seen for overall math performance as a function of OPI-1 and OPI-2 and for correct categorization of isomorphic and transfer problems.

Since previous studies in the literature had not investigated the exact effects of stereotype threat on specific aspects of problem solving (i.e., correct variable identification and selection), significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected. It was believed that an activated negative stereotype would lead to a decrease in performance, similar to overall math performance (Steele & Aronson, 1995). Those in the RANDOM condition, in that sense, performed similarly as those in previous literature. The activated negative stereotype caused a decrease in women's performance in their identifying and selecting the correct variables (n and k) for each problem. The opposite was true for those in the BLOCKED condition, however, as their performance increased with the introduction of an activated negative stereotype.

Correct final answer. Again, a two-way between-groups ANOVA was conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to solve for the correct final solution. Examining performance in correctly solving for the final answer is not independent of the other variables that were examined, such as correctly categorizing the problem as isomorphic or transfer, correctly categorizing the probability problem type, and choosing the correct variables (n and k) to include in solving. This is because if a participant chooses the incorrect probability formula and variables (n and k), for example, she will often not end up with the correct final answer. It was decided, however, to include the other aspects of problem solving (in addition to finding the correct final answer). If solving for the correct final answer was the sole variable investigated, much of the data, from which we can learn how stereotype threat affects aspects of learning, would go to waste.

The main effects and the interaction effect between practice schedule and negative stereotype activation were not statistically significant (all Fs < 1); however, some interesting trends were again noted (see Table 3). For those in the INACTIVE condition, those who studied BLOCKED examples performed better than those studying RANDOM examples. For those in the ACTIVE condition, those studying BLOCKED examples performed much better than those studying RANDOM examples, whose performance somewhat diminished.

Again, those in the RANDOM condition performed similarly as those in previous literature, because the activated negative stereotype led to a decrease in women's math performance in their solving for the correct final answer (Steele & Aronson, 1995). The opposite is true for those studying BLOCKED examples, however, as their performance increased with the introduction of an activated negative stereotype.

Table 3.

Mean Scores of Females Using Variable Practice Schedules under Variable Negative Stereotype Activation

Practice Schedules	INACTIVE		ACTIVE	
	Overall Math Performance			
	OPI-1	OPI-2	OPI-1	OPI-2
BLOCKED	58.41 (20.25)	56.40 (19.95)	63.28 (22.65)	61.93 (22.42)
RANDOM	59.03 (19.42)	55.59 (18.70)	55.33 (14.52)	51.60 (13.92)
	Correct Isomorphic/Transfer Categorization			
BLOCKED	71.88 (19.31)		78.75 (19.59)	
RANDOM	72.08 (19.37)		63.29 (16.03)	
	Correct Categorization of Probability Problem Type			
BLOCKED	54.69 (24.59)		55.21 (33.93)	
RANDOM	57.47 (29.31)		59.23 (22.17)	
	Correct Variable (n and k) Selection			
BLOCKED	68.14 (21.02)		75.42 (16.48)	
RANDOM	70.90 (15.72)		62.65 (12.17)	
	Correct Final Answer			
BLOCKED	30.90 (25.22)		38.33 (28.59)	
RANDOM	23.21 (21.22)		21.23 (15.48)	

Note. Maximum score = 100. Values enclosed in parentheses represent standard deviations.

Overall analyses. When looking at the data as a whole, the performance of those in the ACTIVE condition diminished when studying RANDOM examples. This is similar to the findings in previous studies in which an activated negative stereotype leads to a decrease in performance (Steele & Aronson, 1995). However, the performance of those studying BLOCKED examples actually increased under the effects of a negative stereotype for overall math performance, as well as for categorizing the problem as either an isomorphic or transfer problem, for selecting the correct variables (n and k), and for reaching the correct final solution, unlike previous studies of stereotype threat.

The Effects of Stereotype Threat and Variable Practice Schedules on the Math Performance of High Math Domain Identifying Females

As the literature suggested that those who identify as high math domain identifiers (HIGH IDs) tend to be more affected by stereotype threat (Davies et al., 2002), the same initial analyses were again done looking at only the data from HIGH IDs ($N = 23$). HIGH IDs were classified as those who scored more than the median (an average of 4 on the 2 questions asked) on the administered math domain identification questionnaire, as is seen in the literature (Keller, 2007).

Overall math performance as a function of OPI-1 and OPI-2. A two-way between-groups analysis of variance was conducted, similar to previous analyses, to investigate the impact of variable practice schedules and negative stereotype activation on math performance, as measured by the two indices: OPI-1 and OPI-2.

Though the main effects and the interaction effect among practice schedule, negative stereotype activation, and math domain identification did not reach statistical significance (all Fs < 1), some noteworthy trends were observed (see Table 4). For HIGH IDs, for those in the INACTIVE condition, those who studied BLOCKED examples performed better than those who studied RANDOM examples. For those in the ACTIVE condition, performance of those studying RANDOM examples remained relatively the same, while the performance of those studying BLOCKED examples increased.

In the literature, an activated negative stereotype led to a decrease in performance when solving difficult problems in high math domain identifying females (Keller, 2007). It was thought that novel problems (i.e., probability problems, since participants had not had a college-level probability course) would be difficult. Those in the RANDOM condition, thus, performed similarly as those in previous literature, since the performance of these high math domain-identifying females diminished on these difficult problems under an activated negative stereotype. The opposite was true for those studying BLOCKED examples, however, as their math performance actually improved with the introduction of an activated negative stereotype.

Correct categorization of isomorphic and transfer problems. A two-way between-groups ANOVA was conducted, similar to previous analyses, to investigate the impact of variable practice schedules and negative stereotype activation on HIGH ID participants' ability to correctly categorize each test question as isomorphic or transfer (by applying either one or two formulas during solving).

The main effects and the interaction effect among practice schedule, negative stereotype activation, and math domain identification was not statistically significant (all Fs < 1); however, some interesting trends were seen (see Table 4). For HIGH IDs, for those in the INACTIVE condition, those who studied BLOCKED examples performed better than those who studied RANDOM examples. Then, for those in the ACTIVE condition, though the performance of participants in both groups increased, the performance of those studying BLOCKED examples increased more so than those studying RANDOM examples, similar to findings seen for the overall math performance of HIGH IDs as a function of OPI-1 and OPI-2.

Previous studies in the literature had not investigated the exact effects of stereotype threat on specific aspects of problem solving (i.e., categorization of isomorphic and transfer problem types) for high math domain identifying females. As a result, significant differences in performance under an activated and inactivated stereotype were neither expected nor unexpected. It was believed, however, that performance would be similar to overall math performance where an activated negative stereotype would lead to diminished performance on these difficult (novel) problems for HIGH IDs (Keller, 2007). This was not the case, however, as the performance of participants in both conditions increased when under the effects of an activated negative stereotype.

Correct categorization of probability problem types. A two-way between-groups analysis of variance was also conducted looking at the effects of variable practice schedules and negative stereotype activation on HIGH ID participants' ability to correctly categorize each test question as the appropriate probability problem type.

Though the main effects and the interaction effect among practice schedule, negative stereotype activation, and math domain identification did not reach statistical significance (all Fs < 1), interesting trends were noted (see Table 4). For HIGH IDs, for those in the INACTIVE condition, those who studied BLOCKED examples scored considerably better than those who studied RANDOM examples. For those in the ACTIVE condition, however, the performance of those studying BLOCKED examples decreased some while the performance of those studying RANDOM examples remained approximately the same.

Significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected as previous studies in the literature had not investigated the exact effects of stereotype threat on specific aspects of problem solving for HIGH IDs, such as on categorization of probability problem types. It was believed that performance would be similar to overall math performance where an activated negative stereotype would lead to diminished performance on difficult (novel) problems for HIGH IDs (Keller, 2007). In that sense, those in the BLOCKED condition performed similarly as those in previous literature, where the activated negative stereotype led to a decrease in the math performance of females in correctly categorizing probability problems types. The performance of those in the RANDOM condition remained relatively unchanged.

Correct identification and selection of variables n and k. A two-way between-groups ANOVA was again done in order to explore the impact of variable practice schedules and negative stereotype activation on HIGH ID participants' ability to identify and select variables (n and k) correctly.

The main effects and the interaction effect among practice schedule, negative stereotype activation, and math domain identification were not statistically significant (all Fs < 1). Some noteworthy trends were observed, however (see Table 4). For HIGH IDs, for those in the INACTIVE condition, those who studied BLOCKED examples scored better than those studying RANDOM examples. For those in the ACTIVE condition, the performance of those studying BLOCKED examples increased greatly while the performance of those studying RANDOM examples decreased.

The exact effects of stereotype threat on specific aspects of problem solving (i.e., correct variable identification and selection) for HIGH IDs had not been investigated in previous studies. As a result, significant differences in performance under an activated and inactivated stereotype were, again, neither expected nor unexpected. It was, again, believed that performance would be similar to overall math performance where an activated negative stereotype would lead to diminished performance on difficult (novel) problems for HIGH IDs (Keller, 2007). Those in the RANDOM condition, in that sense, performed similarly as those in previous literature. The activated negative stereotype led to a decrease in women's performance in their identifying and selecting the correct variables (n and k) needed for each problem. The opposite was true for those studying BLOCKED examples, however, as their performance increased with the introduction of an activated negative stereotype. These findings are similar to the performance of HIGH IDs on both overall math performance as a function of OPI-1 and OPI-2 and categorization of isomorphic and transfer problems.

Correct final answer. Again, a two-way between-groups analysis of variance was conducted to investigate the impact of variable practice schedules and negative stereotype activation on HIGH ID participants' ability to solve for the correct final solution. Examining performance in correctly solving for the final answer is not independent of the other variables that were examined for HIGH IDs, such as correctly categorizing the problem as isomorphic or transfer, correctly categorizing the probability problem type, and choosing the correct variables (n and k) to include in solving. This is because if, for example, a participant chooses the incorrect probability formula and variables (n and k), she will often not end up with the correct final answer because the formula and variables she uses will yield a different (wrong) answer. This study decided, however, to include the other aspects of problem solving (in addition to finding the correct final answer). This was because if solving for the correct final answer was the only variable investigated, much of the data, from which we can learn how stereotype threat affects aspects of learning in HIGH IDs, would be wasted.

Though the main effects and the interaction effect among practice schedule, negative stereotype activation, and math domain identification did not reach statistical significance (all *F*s

< 1), interesting trends were noted (see Table 4). For HIGH IDs, for those in the INACTIVE condition, those who studied BLOCKED examples performed better than those who studied RANDOM examples. For those in the ACTIVE condition, performance of both those studying BLOCKED examples and those studying RANDOM examples increased. Neither those in the RANDOM condition nor in the BLOCKED condition performed similarly as those in previous literature (Keller, 2007), as the performance of participants in both conditions increased with the introduction of an activated negative stereotype.

Table 4.

Mean Scores of High Math Domain Identifying Females Using Variable Practice Schedules under Variable Negative Stereotype Activation

Practice Schedules	INACTIVE		ACTIVE	
	Overall Math Performance			
	OPI-1	OPI-2	OPI-1	OPI-2
BLOCKED	65.29 (19.76)	69.01 (17.90)	70.16 (18.54)	69.01 (17.90)
RANDOM	52.81 (14.04)	48.44 (14.47)	53.16 (19.47)	50.47 (18.87)
	Correct Isomorphic/Transfer Categorization			
BLOCKED	73.21 (19.67)		85.94 (12.39)	
RANDOM	58.33 (19.09)		65.00 (20.54)	
	Correct Categorization of Probability Problem Type			
BLOCKED	66.07 (21.61)		62.76 (31.23)	
RANDOM	52.08 (15.73)		52.50 (26.74)	
	Correct Variable (n and k) Selection			
BLOCKED	71.73 (20.12)		80.99 (13.00)	
RANDOM	66.67 (14.77)		61.88 (16.74)	
	Correct Final Answer			
BLOCKED	40.48 (26.87)		46.35 (25.92)	
RANDOM	16.67 (19.09)		22.50 (20.54)	

Note. Maximum score = 100. Values enclosed in parentheses represent standard deviations.

Overall analyses. Overall, HIGH IDs seemed to perform better when studying BLOCKED examples than when studying RANDOM examples. Not only did those studying

BLOCKED examples perform better than those studying RANDOM examples, but they also performed better when a part of the ACTIVE condition than when they were a part of the INACTIVE condition in overall math performance, categorization of isomorphic and transfer problems, identifying and selecting the correct variables (n and k), and finding the correct final answer. Past studies suggested that the performance of HIGH IDs would be unaffected by a negative stereotype when the problems they are solving are *easy* for them (Keller, 2007). This suggests that the high math domain identifying participants might have seen the test problems as *easy* problems as they were not only often unaffected by the negative stereotype, but performed better under its effects.

The Effects of Stereotype Threat and Variable Practice Schedules on Performance on Isomorphic and Transfer Problems

As the final test included both isomorphic and transfer problems, the same initial analyses were again done looking at the data for isomorphic problems and for transfer problems separately. This was done in order to see whether a certain practice schedule impacted performance of certain problem types (isomorphic or transfer) under an activated negative stereotype.

Overall math performance as a function of OPI-1 and OPI-2. A two-way between-groups analysis of variance was conducted to explore the effects of variable practice schedules and negative stereotype activation on math performance of isomorphic problems, as measured by the two indices: OPI-1 and OPI-2.

The main effects and the interaction effect between practice schedule and negative stereotype activation were not found to be statistically significant (all Fs < 1), though some interesting trends were observed in the data (see Table 5). For isomorphic problems, for those in the INACTIVE condition, those who studied BLOCKED examples performed somewhat better than those studying RANDOM examples. For those in the ACTIVE condition, performance of participants in both groups diminished. Those in both the BLOCKED condition and RANDOM condition performed similarly as those in previous literature, where the activated negative stereotype led to a decrease in the math performance of females (Steele & Aronson, 1995).

A two-way between-groups ANOVA was conducted to investigate the impact of variable practice schedules and negative stereotype activation on math performance of transfer (grouping together both near and far transfer) problems, as measured by the two indices: OPI-1 and OPI-2.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all Fs < 1), interesting trends were again noted (see Table 5). For transfer problems, for those in the INACTIVE condition, those who studied BLOCKED examples performed approximately equally to those studying RANDOM examples. For those in the ACTIVE condition, however, those studying BLOCKED examples performed much better than those who studied BLOCKED examples in the INACTIVE condition, while the performance of those studying RANDOM examples diminished compared to those who studied RANDOM examples in the INACTIVE condition. Those in the RANDOM condition performed similarly as those in previous literature, where an activated negative stereotype led to a decrease in the math performance of females (Steele & Aronson, 1995). The opposite was true for those studying BLOCKED examples, however, as their math performance actually increased with the introduction of an activated negative stereotype.

Correct categorization of isomorphic and transfer problems. A two-way between-groups ANOVA was done to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize isomorphic test questions as isomorphic or transfer (by applying either one or two formulas during solving).

Though the main effects and the interaction effect between practice schedule and negative stereotype activation were not statistically significant (all *F*s < 1), some noteworthy trends were observed (see Table 5). For isomorphic problems, for those in the INACTIVE condition, those who studied BLOCKED examples performed better than those studying RANDOM examples. However, for those in the ACTIVE condition, the performance of participants in both groups diminished, though the performance of those studying BLOCKED examples diminished to the extent that participants scored lower than those who studied RANDOM examples.

Previous studies in the literature had not investigated the exact effects of stereotype threat on specific types of problems (isomorphic and transfer) and on specific aspects of problem solving (i.e., categorization of isomorphic and transfer problem types). As a result, significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected. It was believed, however, that performance would be similar to overall math performance where an activated negative stereotype would lead to diminished performance (Steele & Aronson, 1995). In that sense, those in both the BLOCKED condition and RANDOM condition performed similarly as those in previous literature in that the activated negative stereotype led to a decrease in the math performance of females. In this case, it was their performance on correctly categorizing isomorphic problems as isomorphic or transfer that decreased. This diminishing of performance was true more so for those in the BLOCKED condition than those in the RANDOM condition.

A two-way between-groups analysis of variance was also conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize transfer test questions as isomorphic or transfer (by applying either one or two formulas during solving).

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all Fs < 1), interesting trends were noted (see Table 5). For transfer problems, for those in the INACTIVE condition, those who studied BLOCKED examples performed approximately equally to those who studied RANDOM examples. However, for those in the ACTIVE condition, the performance of participants studying BLOCKED examples considerably increased while the performance of those studying RANDOM examples diminished greatly.

Again, significant differences in performance under an activated and inactivated stereotype were neither expected nor unexpected as previous studies in the literature had not investigated the exact effects of stereotype threat on specific types of problems and on specific aspects of problem solving. It was believed that performance would be similar to overall math performance where an activated negative stereotype would lead to a decrease in performance (Steele & Aronson, 1995). In that sense, those in the RANDOM condition performed similarly as those in previous literature in that the activated negative stereotype led to a decrease in the math performance of females. In this case, it was their performance on correctly categorizing transfer problems as isomorphic or transfer that decreased. The opposite was true for those studying BLOCKED examples, however, as their performance increased with the introduction of an activated negative stereotype.

Correct categorization of probability problem types. A two-way between-groups analysis of variance was done exploring the effects of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize isomorphic test questions as the appropriate probability problem type.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all Fs < 1), some interesting trends were seen in the data (see Table 5). For isomorphic problems, for those in the INACTIVE condition, those who studied BLOCKED examples scored better than those who studied RANDOM examples. For those in the ACTIVE condition, the performance of participants in both groups diminished. Again, as the exact effects of stereotype threat on specific types of problems (isomorphic and transfer) and on specific aspects of problem solving (i.e., categorization of probability problem types) had not been previously investigated, significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected. It was hypothesized that performance would be similar to overall math performance where an activated negative stereotype would lead to a decrease in performance (Steele & Aronson, 1995). In that sense, those in both the BLOCKED and RANDOM conditions performed similarly as those in previous literature in that the activated negative stereotype led to a decrease in the math performance of women. In this case, it was their performance on correctly categorizing the probability problem type of isomorphic problems that decreased.

A two-way between-groups ANOVA was conducted looking at the impact of variable practice schedules and negative stereotype activation on participants' ability to correctly categorize transfer test questions as the appropriate probability problem type.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all *F*s < 1), interesting trends were noted (see Table 5). For transfer problems, for those in the INACTIVE condition, those who studied RANDOM examples scored approximately the same as those who studied BLOCKED examples. For those in the ACTIVE condition, the performance of participants in both groups increased, but the performance of those studying RANDOM examples did more so. Again, significant differences in performance under an activated and inactivated stereotype were neither expected nor unexpected because previous studies in the literature had not investigated the exact effects of stereotype threat on specific types of problems and on specific aspects of problem solving. It was thought that an activated negative stereotype would lead to a diminished performance, similar to overall math performance (Steele & Aronson, 1995). In that sense, neither those in the BLOCKED nor RANDOM condition performed similarly as those in previous literature in that the performance of participants in both groups increased somewhat under the effects of an activated negative stereotype. In this case, it was their performance on correctly categorizing the probability problem type of transfer problems that increased.

Correct identification and selection of variables n and k. A two-way between-groups ANOVA was done in order to look at the effects of variable practice schedules and negative stereotype activation on participants' ability to identify and select variables (n and k) correctly for isomorphic problems.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation were not statistically significant (all *F*s < 1), some interesting trends were noted (see Table 5). For isomorphic problems, for those in the INACTIVE condition, those who studied RANDOM examples scored somewhat better than those studying

BLOCKED examples. For those in the ACTIVE condition, however, the performance of those studying BLOCKED examples increased greatly while the performance of those studying RANDOM examples decreased to considerably less than those in the BLOCKED condition. Previous studies in the literature had not investigated the exact effects of stereotype threat on specific types of problems (isomorphic and transfer) and on specific aspects of problem solving (i.e., identification and selection of variables [n and k]). As a result, significant differences in performance under an activated and inactivated stereotype were not necessarily expected or unexpected. It was believed that performance would resemble overall math performance where an activated negative stereotype would lead to a decrease in performance (Steele & Aronson, 1995). Those studying RANDOM examples, in that sense, performed similarly as those in previous literature. The activated negative stereotype caused a decrease in women's performance in their selecting the correct variables (n and k) for isomorphic problems. The opposite was true for those studying BLOCKED examples, however, as their performance increased with the introduction of an activated negative stereotype.

A two-way between-groups analysis of variance was conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to select variables (n and k) correctly for transfer problems.

The main effects and the interaction effect between practice schedule and negative stereotype activation were not statistically significant (all *F*s < 1). However, some noteworthy trends were observed in the data (see Table 5). For transfer problems, for those in the INACTIVE condition, those who studied RANDOM examples scored somewhat better than those studying BLOCKED examples. For those in the ACTIVE condition, however, the performance of those studying BLOCKED examples increased greatly while the performance of those studying RANDOM examples decreased to considerably less than those in the BLOCKED condition. These findings are similar to participants' performance selecting variables (n and k) for isomorphic problems. Again, previous studies in the literature had not investigated the exact effects of stereotype threat on specific types of problems and on specific aspects of problem solving. As a result, significant differences in performance under an activated and inactivated stereotype were neither expected nor unexpected. It was believed that performance would be similar to overall math performance where an activated negative stereotype would lead to a decrease in performance (Steele & Aronson, 1995). Those in the RANDOM condition, in that sense, performed similarly as those in previous literature. The activated negative stereotype led to a decrease in women's performance in their identifying and selecting the correct variables (n and k) for transfer problems. The opposite was true for those in the BLOCKED condition, however, as their performance increased with the introduction of an activated negative stereotype.

Correct final answer. A two-way between-groups ANOVA was again conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to solve for the correct final solution for isomorphic problems. Again, it is noted that examining performance in correctly solving for the final answer in both isomorphic and transfer problems is not independent of the other variables that were examined, such as correctly categorizing the problem as isomorphic or transfer, correctly categorizing the probability problem type, and choosing the correct variables (n and k) to include in solving. This is because, for example, if a participant chooses the incorrect probability formula and variables (n and k), she will often not end up with the correct final answer because the incorrect formula and/or variables will yield a different (wrong) answer. It was decided to include the other aspects of problem solving (in addition to finding the correct final answer). If solving for the correct final answer was the single variable investigated, much of the data, from which we can learn how stereotype threat affects aspects of learning in isomorphic problems, would go to waste.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all *F*s < 1), some interesting trends were noted (see Table 5). For isomorphic problems, for those in the INACTIVE condition, those who studied BLOCKED examples performed considerably better than those who studied RANDOM examples. For those in the ACTIVE condition, performance of both those studying BLOCKED and those studying RANDOM examples increased. Neither those in the RANDOM condition nor in the BLOCKED condition performed similarly as those in previous literature (Steele & Aronson, 1995), as the performance of participants in both conditions increased with the introduction of an activated negative stereotype.

A two-way between-groups analysis of variance was also conducted to investigate the impact of variable practice schedules and negative stereotype activation on participants' ability to solve for the correct final solution for transfer problems. It is, again, noted that examining performance in correctly solving for the final answer in isomorphic problems is not independent of the other variables that were examined. This was done in order to not allow much of the data, from which we can learn how stereotype threat affects aspects of learning in transfer problems, to go to waste.

Though the main effects and the interaction effect between practice schedule and negative stereotype activation did not reach statistical significance (all *F*s < 1), interesting trends were again observed in the data (see Table 5). For transfer problems, for those in the

INACTIVE condition, those who studied BLOCKED examples performed better than those who studied RANDOM examples. For those in the ACTIVE condition, the performance of those who studied BLOCKED examples increased considerably while the performance of those who studied RANDOM examples diminished. Those in the RANDOM condition performed similarly as those in previous literature, where the activated negative stereotype led to a decrease in women's math performance in their solving for the correct final answer for transfer problems (Steele & Aronson, 1995). The opposite was true for those in the BLOCKED condition, however, as their performance increased with the introduction of an activated negative stereotype.

Table 5.

Mean Scores for Isomorphic and Transfer Math Problems of Females Using Variable Practice Schedules under Variable Negative Stereotype Activation

Practice	Isomorphic Problems				Transfer Problems			
Schedules	INACTIVE		ACTIVE		INACTIVE		ACTIVE	
	Overall Math Performance							
	OPI-1	OPI-2	OPI-1	OPI-2	OPI-1	OPI-2	OPI-1	OPI-2
BLOCKED	75.00	75.00	74.25	73.75	53.43	50.78	59.85	58.23
	(24.33)	(23.08)	(24.67)	(25.48)	(21.18)	(21.07)	(24.83)	(24.68)
RANDOM	74.09	70.45	70.69	68.75	54.28	50.89	50.74	46.30
	(21.25)	(20.37)	(21.52)	(18.22)	(22.57)	(21.84)	(15.69)	(15.43)
	Correct Isomorphic/Transfer Categorization							
BLOCKED	100.00 (0.00)		90.00 (31.62)		63.06 (25.12)		75.00 (27.50)	
RANDOM	95.45 (15.08)		94.44 (16.67)		65.15 (24.10)		53.70 (20.03)	
	Correct Categorization of Probability Problem Type							
BLOCKED	66.67 (32.57)		60.00 (45.95)		51.25 (25.89)		54.17 (34.08)	
RANDOM	72.73 (41.01)		66.67 (43.30)		52.12 (30.99)		57.41 (20.60)	
	Correct Variable (n and k) Selection							
BLOCKED	83.33 (30.77)		90.00 (17.48)		63.54 (22.34)		70.42 (19.98)	
RANDOM	86.36 (17.19)		80.56 (24.30)		66.59 (20.12)		57.41 (13.63)	
	Correct Final Answer							
BLOCKED	50.00 (42.64)		55.00 (49.72)		25.28 (24.01)		33.33 (28.33)	
RANDOM	27.27 (41.01)		33.33 (35.36)		19.70 (24.52)		16.67 (14.43)	

Note. Maximum score = 100. Values enclosed in parentheses represent standard deviations.

Overall analyses. In terms of performance on isomorphic and transfer problems, both those in the BLOCKED condition and RANDOM condition performed about equally in terms of overall performance on isomorphic problems. For overall performance on transfer (both near and far) problems, not much change was seen between those in the ACTIVE condition and INACTIVE condition, though the performance of those studying BLOCKED examples increased a bit when part of the ACTIVE condition while the performance of those studying RANDOM examples diminished slightly.

In terms of correct categorization of isomorphic and transfer problems, for those in the INACTIVE condition, all participants studying BLOCKED examples correctly categorized isomorphic problems. This performance diminished, however, once a negative stereotype was introduced (as did the performance of those in the RANDOM condition). Those studying BLOCKED examples were also better able to categorize transfer problems than those studying RANDOM examples. For those in the ACTIVE condition, those studying BLOCKED examples actually became better at doing so, while the performance of those studying RANDOM examples diminished.

In terms of correctly categorizing the isomorphic probability problem types, performance of participants studying both RANDOM examples and BLOCKED examples diminished when part of the ACTIVE condition, as the literature suggests. Those studying RANDOM examples performed better than those studying BLOCKED examples. For the transfer problems, however, the opposite occurred where participants in both the RANDOM condition and BLOCKED condition performed better when part of the ACTIVE condition. For both isomorphic and transfer problems, those studying BLOCKED examples were better able to select the correct variables (n and k) than those who studied RANDOM examples, and performed better when part of the ACTIVE condition while the performance of those in the RANDOM condition decreased. Participants who studied BLOCKED examples again outperformed their counterparts who studied RANDOM examples in terms of solving for the correct answer of isomorphic problems, though the performance of participants in both group's increased when part of the ACTIVE condition. The same was true for performance on transfer problems, though on these problems, performance of those studying RANDOM examples diminished slightly when part of the ACTIVE condition.

Conclusions

Overview of Analyses

Though the results of this study were not statistically significant, examining the trends seen in the data yielded some interesting results. As a whole, the tendency was for performance of those in the blocked group to be better than those in the random group. Another tendency, interestingly, was for the performance of these blocked order participants to increase once a negative stereotype was introduced (not decrease like in the literature [Steele & Aronson, 1995]).

Based on these results it is suggested that a blocked order might be best for acquisition of material, especially when under the effects of a negative stereotype.

Limitations of the Study

This study had some limitations, such as the lack of statistical power; ideally, more than 48 participants would have been part of the study.

It also might have been beneficial to investigate whether or not the presented negative stereotype truly did or did not have an effect on participants. This could have been done a number of ways. For example, a questionnaire could have been administered at the beginning of the experiment asking participants why they believe men outnumber women in the mathematics and related fields. A similar questionnaire could have then been administered at the end of the experiment. If participants stated that the lesser number of females in mathematics-related fields is due to their inability to perform as well as men in mathematics, it could be assumed that the activated negative stereotype did indeed affect their performance.

Future Research

There is still a great deal that needs to be done in this field. Not only can studies like this one be expanded, but new avenues can also be investigated. It would be beneficial to look at the effects of stereotype threat on a blocked and random order practice schedule in terms of retention as well, in addition to acquisition as was investigated in this study.

Another interesting and related topic would be to investigate ways that learning materials could help working memory under the effects of stereotype threat. Past studies have suggested that increases in environmental stressors (like stereotype threat) can cause a decrease in working memory, which leads to a decrease in performance (Beilock, 2008; Schmader & Johns, 2003). Trends suggesting this were seen in this study, as those in the random condition did not perform as well as those in the blocked condition generally. This could have been due to the fact that the random condition might have been more taxing on working memory. This might have been because the random condition required participants to keep knowledge of four types of probability problems in their working memory throughout the learning portion as the information was presented over time and not all at once like in the blocked condition.

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